Assessment of Primary Productivity of Phytoplanktons of Kolayat Lake, Bikaner (Rajasthan), India

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Abstract

The primary productivity of phytoplanktons of Kolayat lake, Bikaner has been assessed for a period of 12 months from July, 2006 to June, 2007. The monthly primary productivity in the lake revealed a seasonal cycle in the values for gross and net primary production. The gross and net primary productivity of phytoplankton population were observed to be maximum during winter season and minimum during monsoon period. Gross primary productivity (GPP) varied between 2.108 gC/m^3/day to 3.285 gC/m^3/day in shallow water zone and 2.132 gC/m^3/day to 3.212 gC/m^3/day in deep water zone.

Key words: Kolayat Lake, Phytoplanktons, Primary productivity

Introduction

The primary productivity of the phytoplanktons is one of the most important sources of energy input in the aquatic ecosystem. The photosynthetic fixation of carbon dioxide and its quantitative measurement is considered a vital index of the productive potential of any aquatic ecosystem. Productivity in a broad sense refers to concept of organic matter synthesis potential which means ability of an area to support a biological population and sustain a level of growth and respiration (Raymount, 1966). Primary production studies are of paramount interest in understanding the effect of pollution on system's efficiency. High rates of production in natural and cultural ecosystems occur when physico-chemical factors are favorable (Sultan *et al.*, 2003). Primary productivity of different water bodies have been studied by Harikrishnan and Abdul (2000); Shukla and Pawar (2000); Mandal (2002); Kumar and Singh (2006); Hujare and Mule (2007); Koli and Ranga (2011) and Mishra *et al*., (2012). Kolayat Lake, is one of the important fresh water lake in the arid region and situated about 55 km at Kolayat in the south-west of Bikaner city. It lies at located 27°50' N latitude and 73°57' E longitude. The depth of lake varies from 3 feet (shallow water zone) to 20 feet (deep water zone) with maximum towards south, and it has a capacity of 100 mcft. of water. It is a holy place of great significance not only in this part of the country but also throughout India. The lake situated along a temple of Kapil Muni, regarded as the originator of the "Sankhya Darshan" of Indian Hindu Philosophy, is the central feature of the place.

Material and Methods

The primary productivity was determined at monthly intervals for the period of one year (July, 2006 to June, 2007). The oxygen method was used for measuring primary production by exposing the sample of phytoplanktons in light and dark bottles (Gardner and Grann, 1927). Bottles were painted black besides wrapping them with black cellulose tape. All the samples were suspended at 0.5 metre depth for incubation period of 6 hrs. Oxygen changes were estimated by the modified Winkler's method (APHA, 1998). All oxygen values were converted to carbon by multiplying them with a factor 0.375 (Antia *et al*., 1965). The productivity values were expressed as gC/m^3/day, taking 12 hours photoperiod in the course of a day.

Results

The gross and net primary productivity of the phytoplanktons of shallow water zone and deep water zone were observed and found that they showed monthly and seasonal variations (Table -1 & 2). In shallow water zone, maximum gross primary productivity (3.285 gC m^{-3} day^{-1}) was recorded during January and minimum (2.108 gC m^{-3} day^{-1}) during July. Similarly, the respiration was also recorded maximum (2.202 gC m^{-3} day^{-1}) and minimum (1.148 gC m^{-3} day^{-1}) during the same months. The net primary productivity (NPP) varied from 0.884 gC m^{-3} day^{-1} to 1.183 gC m^{-3} day^{-1} with minimum and maximum during May and January, respectively. In respect of different season, the values of gross production and net production were observed to be maximum during the winter followed in a decreasing order by rainy and summer season. The present study revealed distinct seasonal and trimodal pattern of variation in the Gross primary productivity value, having peak in September (Rainy), January (Winter) and June (Summer). The higher values of respiration were observed during winter months. Respiration % of gross production was maximum (67.03%) during January and minimum (54.19%) during September. The net and gross ratio ranged from 0.356 (December) to 0.458 (September) in shallow water zone.

In deep water zone, the gross production varied from 2.132 gC m^{-3} day^{-1} to 3.212 gC m^{-3} day^{-1} with minimum and maximum during July and January, respectively. Respiration was also recorded to be maximum (2.105 gC m^{-3} day^{-1}) during January and minimum (1.052 gC m^{-3} day^{-1}) during March while net production was maximum (1.488 gC m^{-3} day^{-1}) during December and minimum (0.934 gC m^{-3} day^{-1}) during July. In respect of seasonal variation, maximum values of net production were observed during winter followed in a decreasing order by summer and rainy season. Respiration % of gross production was higher in winter decreasingly followed by rainy and summer season. The net v/s gross production was observed to varied between 0.347 (January) to 0.545 (March) in deep water zone

Table - 1. Monthly Variation in Primary Productivity and Respiration of Phytoplankton Community in Shallow Water Zone of Kolayat Lake, Bikaner, During 2006-07

Parameters	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
Gross primary Productivity gC/m^3/day	2.108	2.226	2.316	2.118	2.722	3.048	3.285	2.689	2.341	2.227	2.212	2.278
Respiration gC/m^3/day	1.148	1.210	1.255	1.200	1.598	1.952	2.202	1.514	1.272	1.265	1.328	1.358
Net primary Productivity gC/m^3/day	0.960	1.016	1.061	0.918	1.124	1.096	1.183	1.175	1.069	0.962	0.884	0.920
Net production v/s Gross production	0.455	0.456	0.458	0.433	0.413	0.356	0.360	0.436	0.457	0.432	0.401	0.404
Respiration % of Gross production	54.46	54.35	54.19	56.66	58.71	64.04	67.03	56.30	54.34	56.80	59.85	59.61

Table - 2. Monthly Variation in Primary Productivity and Respiration of Phytoplankton Community in Deep Water Zone of Kolayat Lake, Bikaner, During 2006-07

Parameters	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
Gross primary Productivity gC/m^3/day	2.132	2.278	2.283	2.275	2.702	3.002	3.212	2.472	2.312	2.235	2.488	2.480
Respiration gC/m^3/day	1.198	1.185	1.248	1.272	1.488	1.514	2.105	1.428	1.052	1.238	1.416	1.501
Net primary Productivity gC/m^3/day	0.934	1.093	1.035	1.003	1.214	1.488	1.107	1.044	1.260	0.997	1.072	0.979
Net production v/s Gross production	0.438	0.479	0.453	0.441	0.449	0.496	0.347	0.422	0.545	0.446	0.431	0.395
Respiration % of Gross production	56.19	52.02	54.66	55.91	55.07	50.43	65.54	57.77	45.50	55.39	56.91	60.52

Discussion

The measurement of phytoplankton productivity helps to understand conservation ratio at various trophic level and resources as an essential input for proper management of water reservoir. In present investigation, higher rate of primary productivity was recorded in shallow water zone than deep water zone of Kolayat Lake. This can be attributed to the comparable morphometric features of the two zones. During the present study definite trend of seasonal variation in primary

productivity was observed in both the zone and trimodal pattern of increased productivity was noticed. Lowest rate of production was recorded during monsoon. The decline in the productivity during rainy season may be due to dilution of lake waters and subsequent reduction of phytoplankton density. Similar findings were made by Singh (1963); Hujare and Mule (2006); Kumar and Singh (2006) and Kumar and Choudhary (2007). The higher values of respiration observed during winter months may be due to higher phytoplankton density. Ganf (1972) concluded that value of community respiration greater than 40% of gross productions are a characteristic of eutrophication. In present investigation, respiration percentage was observed over 40% throughout the year in both shallow and deep water zone and supported the eutrophic status of lake.

From the net primary productivity and respiration percentage of gross primary productivity in the present study, it may be suggested that the Kolayat lake is progressing towards eutrophication and it needs immediate remedial measures as the lake is the source of livelihood for thousand of local people and is important for floral and faunal diversity.

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